Physicians' communication of Down syndrome screening test results: The influence of physician numeracy

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Purpose: We investigated three questions: (1) How do obstetrician-gynecologists communicate positive and negative test results? (2) When reporting screening test results, do obstetrician-gynecologists use quantitative or qualitative information? and (3) Is physician numeracy (i.e., the ability to use and understand numbers) associated with use of quantitative or qualitative information? **Method:** Obstetrician-gynecologists ($N = 203$; 55.6% response rate) who were members of the American College of Obstetricians and Gynecologists completed a survey about their communication of Down syndrome screening test results, an Objective Numeracy Scale, and the Subjective Numeracy Scale. **Results:** Higher scores on the Subjective Numeracy Scale and younger age predicted obstetrician-gynecologists' use of numbers to explain testing results. The Objective Numeracy Scale did not predict use of numbers. Gender was correlated with scores on the Subjective Numeracy Scale ($r = 0.2$) and the Subjective Numeracy Scale-Ability Subscale ($r = 0.3$), with men scoring higher than women when controlling for age. Open-ended questions revealed that communication strategies vary, with approximately one in three obstetrician-gynecologists providing numerical information, and frequency format being the commonly used numerical format. **Conclusion:** Although physicians are often overlooked in the problem of low health literacy, it is important that we continue to investigate the impact of physician numeracy on patient care. ***Genet Med* 2011:13(8):744–749.**

Key Words: *Down syndrome, screening, numeracy, communication, obstetrician-gynecologists*

Most obstetrician-gynecologists (ob-gyns) routinely offer women screening for Down syndrome during pregnancy.[1] Among the Down syndrome screening tests available, the second trimester serum quadruple screen is the most frequently used among ob-gyns.[1] This test identifies women whose fetus is at an increased risk for Down syndrome by measuring four biochemical markers in the maternal serum (alpha-fetoprotein, human chorionic gonadotropin, unconjugated estriol, and inhibin A). These results are used to adjust a woman's risk for having a child with Down syndrome based on her age and provide a numerical value of risk that needs to be interpreted in the context of gestational age, maternal age, obstetrical and family history, personal values and ultrasound findings. The detection rate (sensitivity) for this screening test is approximately 80% at a false-positive screening rate of 5%.[2] As the screening tests only estimate the risk of Down syndrome, further diagnostic tests (such as amniocentesis) are needed to confirm whether the fetus has Down syndrome.

The way in which Down syndrome screening results are presented has been found to impact how patients respond to the results of their screening test. For example, when given risk estimates from a Down syndrome screening test, women's judgments were more accurate when numbers were presented as rates (e.g., 2.7 in 10,000) rather than proportions (e.g., 1 in 3703).[3] In addition, supplementing the numerical results of Down syndrome screening tests with qualitative labels such as "abnormal" and "positive" has been found to affect patients' perceptions and decisions. The use of these labels is associated with greater perceived risk, more worry, and more interest in pursuing diagnostic testing.[4] Although research has looked at how the format of information affects patients, complementary research on how physicians communicate the results to their patients is lacking. Such research would reveal whether efforts to improve physician-patient communication regarding Down syndrome screening are needed.

Health literacy can be defined as the ability to perform basic reading and numerical tasks required to function in the healthcare environment.[5] Both literacy and numeracy are included under the umbrella of health literacy. Similar to how literacy is the ability to use and understand words, numeracy is the ability to use and understand numbers. Numeracy has been found to independently affect healthcare decisions and outcomes.[6] Although physicians are often overlooked in the problem of low health literacy, they are part of the collective statistical illiteracy, that is, the cycle of illiteracy among patients, physicians, media, and society.[7] With the increase in evidence-based medicine (using empirical research to guide medical decisions and practices), physicians are expected to understand and apply statistical concepts such as confidence intervals (CIs), likelihood ratios, *P* values, and number needed to treat. A recent review suggests that few medical school curricula currently include training on these and other physician numeracy skills.[8] Physicians have been found to have problems with some numeracy tasks, for example, ob-gyns have had trouble calculating the likelihood that a fetus has Down syndrome after a positive screening test.[9]

This study was conducted to assess how ob-gyns communicate results of the second trimester serum screening tests to their patients. Specifically, we investigated three questions: (1) How do ob-gyns communicate positive and negative test results? (2) When reporting screening test results, do ob-gyns use quantita-

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tive or qualitative information? and (3) Is physician numeracy associated with use of quantitative or qualitative information?

MATERIALS AND METHODS

Sample

Four hundred practicing ob-gyns who are members of the American College of Obstetricians and Gynecologists were randomly sampled and invited to participate. Physicians who were selected were part of the Collaborative Ambulatory Research Network, which comprises ob-gyns who volunteer to complete 3–5 survey studies each year. Of the 400 ob-gyns sampled, 59.5% ($n = 238$) responded; however, five reported that they had retired, and 30 declined to participate for a total of 203 respondents and a response rate of 55.6% (203/365).

A mixed-method design (both an electronic and a paper version of the survey) was used for this study. Information about the study and the link to the online survey were e-mailed to the physicians. After four e-mail reminders, a paper version of the survey was mailed to all nonresponders (and those who did not have e-mail addresses). One paper reminder mailing was sent.

Survey

The survey included demographic questions (age, gender, and number of Down syndrome patients seen in the past year), questions about the communication of Down syndrome screening results, the Objective Numeracy Scale (ONS), and the Subjective Numeracy Scale (SNS). Additional questions from this survey are reported elsewhere.

Questions about communication of Down syndrome screening results

To assess ob-gyns' communication of Down syndrome screening test results, four questions were created by the authors for this study. Two open-ended questions and two forced-choice questions were asked. The first open-ended question asked, "If your patient's second trimester screening result reveals that their fetus has Down syndrome, how do you usually communicate and explain these results to your patient?" The second open-ended question asked, "If your patient's second trimester serum screening test reveals that their fetus does not have Down syndrome, how do you usually communicate and explain these results to your patient?"

A forced choice question was asked to assess how ob-gyns report screening test results in general, "In general, when talking about the results of a screening test with your patients, do you most often refer to the results as being …? (check one)" The response options were "positive or negative," "normal or abnormal," "low risk or high risk," "I provide patients with a numerical value for their risk," "varies by test," "I do not communicate test results to patients," and "none of the above." The final question, also a forced choice question, asked participants, "In general, if you use numbers to communicate or explain the risks associated with screening tests to patients (i.e., the likelihood of something), which do you most often use? (check one)." Response options were "Frequency (e.g., 1 of 100)," "Percent (e.g., 10%)," "Decimal (e.g., 0.50)," "Fraction (e.g., 1/100)," "I do not use numbers to communicate risks to patients," and "Other."

Objective Numeracy Scale

The Schwartz Numeracy Scale[10] was used as a measure of objective numeracy. The scale was developed not only to measure numeracy in the general population but has also been used to assess physician numeracy in previous research with medical providers.[7,11] It is made up of three questions: (1) a conversion from a percentage to a frequency, (2) a conversion from a frequency to a percentage, and (3) an estimation of how many heads there will be in 1000 coins flips. It has been found to have good internal reliability ($\alpha = 0.56–0.80$).[6]

Subjective Numeracy Scale

The SNS[4,12] consists of eight questions to which participants responded on scales from 1 to 6. Four questions measured subjective numerical ability (SNS-Ability subscale) and four questions measured preferences for numerical information (SNS-Preference subscale). The SNS has been found to have good internal reliability ($\alpha = 0.82$).[6]

Data analysis

To create a categorical variable for age, participants were grouped into the following roughly equal sized groups: 33–43-year olds, 44–55-year olds, and 56–77-year olds. Participant's responses to the subjective numeracy questions were averaged to compute SNS scores, which could range from 1 to 6. To compute the ONS scores, correct answers were labeled as 1 and incorrect answers were labeled as 0, and then the answers were summed for a total ranging from 0 to 3. For the ONS, unanswered questions were counted as incorrect, and those who did not answer any questions were not included in analyses. For the SNS analyses, those who answered some, but not all, of the six questions were not included in the analyses ($n = 10$). Responses from the forced-choice question were used to compare participants who use quantitative versus qualitative information to communicate the results of screening tests. Those who indicated that they use "numerical value for risk" were grouped as the quantitative group ($n = 68$) and those who indicated that they use "positive or negative," "normal or abnormal," or "low risk or high risk" were grouped into the qualitative group ($n = 92$). Those who indicated that that it "varies by test" or "other" were not included in either group.

Data were analyzed using a personal computer-based version of SPSS 17.0 (SPSS Inc., Chicago, IL). Descriptive and frequency data were computed for primary analysis. One-way analysis of variance was used for continuous variables; χ^2 analyses were conducted for categorical variables. Pearson's r was used for correlation analyses. Logistic regression was used with binary dependent variables, and linear regression was used for nonbinary dependent variables. Significance was evaluated at $\alpha = 0.05$ and CIs of 95%.

RESULTS

Demographics

Respondent demographics are listed in Table 1. The sample was about half women. The mean age was 50.9 years, but men were significantly older ($M = 54.9$, SD = 9.6) than women ($M = 46.7$, SD = 7.8) ($F(1,192) = 40.1$, $P < 0.001$). The mean number of Down syndrome affected pregnancies that they treated in the past year was 1.79 (SD = 3.9). The number of patients was not associated with gender or age.

Communication of screening results

Responses to open-ended questions were coded for descriptors about how risks are communicated to their patients, and results are listed in Tables 2 and 3. The most common phrase that ob-gyns reported saying, for both positive and negative test

Table 1 Demographics of respondents (n = 203)

Demographics of respondents (n = 203)	
Mean age	50.9 (SD = 9.6)
% Female	49.5%
Number of DS patients in past year	
Mean	1.79 (SD = 3.9)
Mode	0
Range	0–25

DS, Down syndrome.

Table 2 Responses that physicians gave in an open-ended question about how they communicate and explain the results of second trimester serum screening test when the test is positive (n = 115, not all respondents provided an answer)

Explanation of positive results	Percentage of respondents indicating (n = 115)
Test is only a screen, not a diagnostic test	38
Mention false positive	11
Say "positive"	10
Say "abnormal"	4
Say "increased risk"	18
Provide numbers for patient	21
Mention further testing	
Amniocentesis	17
Ultrasound	4
Both amniocentesis and ultrasound	20
Testing in general	21
Refer	17
Other	5

Table 3 Responses that physicians gave in an open-ended question about how they communicate and explain the results of second trimester serum screening test when the test is negative (n = 106, not all respondents provided an answer)

Explanation of negative results	Percentage of respondents indicating (n = 106)
Test is only a screen, not a diagnostic test	24
The risk is not zero	7
Mention false positive	6
Say "negative"	21
Say "normal"	20
Say "low chance" or "low risk"	20
Say "no increased risk"	13
Provide numbers for patient	28
Mention further testing	
Amniocentesis	6
Ultrasound	2
Both amniocentesis and ultrasound	1
Testing in general	4
Other	10

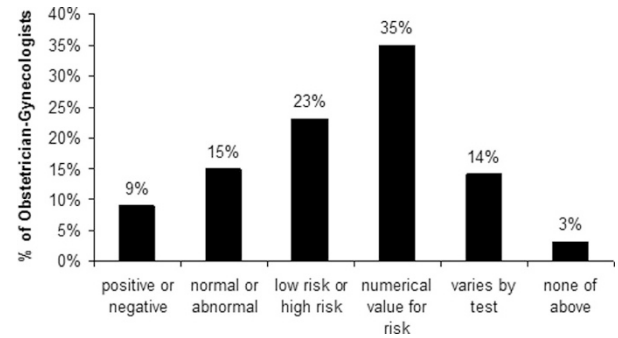

Fig. 1. When asked "In general, when talking about the results of a screening test with your patients, do you most often refer to the results as being …?"

results, was that the test is only a screening test, not a diagnostic test; however, they did so more when results were positive (38%) than when results were negative (24%). Ob-gyns were also more likely to talk about further testing with positive results (62%) than negative test results (13%). Respondents were more likely to use both qualitative and quantitative information when communicating negative results of the Down syndrome screening test.

Figure 1 displays responses to the forced-choice question about how physicians explain results from screening tests in general. Providing numbers for patients when talking about screening test results was the most commonly reported information format (35%), followed by the use of "low risk" and "high risk" phrases (23%). Figure 2 shows male and female ob-gyns who provide numbers, broken down by age group. Younger males use numerical information more than the older male ob-gyns (59% among 33–43-year olds and 25% among 56–77-year olds). In a logistic regression where age and gender were predictors of using numbers, younger age significantly predicted using numbers ($\beta = -0.04$, $P = 0.017$) but gender did not.

Figure 3 shows how patients responded to the forced choice questions about which types of number formats they use to communicate risks. The frequency format was by the far the most commonly endorsed. These responses did not vary by any demographic variables.

Subjective Numeracy Scale

A total of 189 of the 203 respondents answered the SNS questions. The mean SNS score was 4.9 (SD = 0.7) (on a 6-point scale). The mean score on the SNS-Ability subscale was

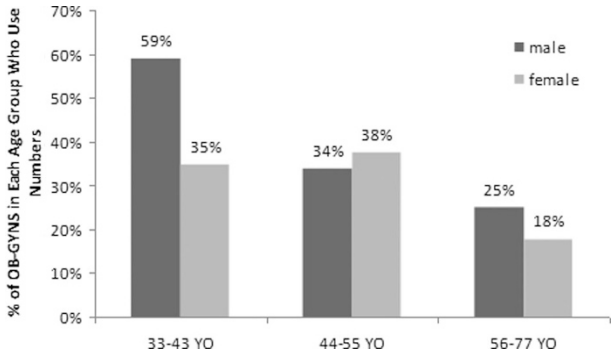

Fig. 2. When male and female ob-gyns were asked how they generally communicate the results of a screening tests with their patients, more men used numerical information than women in the 33–43 years age group and the 56–77 years age group.

5.0 (SD = 0.8), and the SNS-Preference subscale was 4.7 (SD = 0.9).

Mean scores on the SNS were significantly greater for men (M = 5.0, SD = 0.7) than women (M = 4.7, SD = 0.8) ($F(1,184) = 7.9$, $P = 0.006$, when controlling for age). Men also scored significantly higher on the SNS-Ability (M = 5.3, SD = 0.7 and M = 4.8, SD = 0.9, respectively; $F(1, 187) = 11.9$, $P = 0.001$).

Linear regression analyses with age (continuous variable), gender, and number of Down syndrome patients seen per year were used to predict SNS scores. Gender ($B = -0.3$, $P = 0.012$) and number of cases of Down syndrome patients ($B = 0.03$, $P = 0.026$) were significant predictors of the SNS scores. Only gender significantly predicted SNS-Ability Subscale scores ($B = -0.50$, $P < 0.001$), and only number of cases of Down syndrome predicted SNS-Preference score ($B = 0.05$, $P = 0.002$).

Objective Numeracy Scale

A total of 174 of the 203 respondents answered the ONS questions, 66.1% answered all three questions correctly, 24.1% answered two correctly, 7.5% answered one correctly, and 2.3% answered none correctly. In correlation and linear regression analyses, neither age nor gender was associated with ONS scores.

Comparison of ONS and SNS

The ONS is weakly correlated with the SNS total ($r = 0.282$, 95% CI: 0.15–0.41), SNS-Ability subscale ($r = 0.31$, 95% CI: 0.17–0.43), and the SNS-Preference subscale ($r = 0.147$, 95% CI: 0.01–0.29). To further compare the scores of the SNS and the ONS, we grouped participants into a high objective group (answered 3 correctly) and a moderate/low objective group (answered 2 or fewer correctly) and calculated the mean ONS and SNS scores for each group. Scores on the SNS, SNS-Ability subscale, and SNS-Preferences subscale were significantly higher for the high objective group ($F(1,163) = 21.7$, $P < 0.001$; $F(1,167) = 28.4$, $P < 0.001$; and $F(1,168) = 4.3$, $P < 0.04$, respectively). Figure 4 displays the mean SNS score for the high and low objective numeracy groups (far left two bars) and shows that the high objective numeracy group had a greater mean SNS score than the low objective numeracy group. The mean SNS subscale scores for the high and low objective numeracy groups are also displayed.

Numeracy and communication

When asked how ob/gyns usually communicate the results of screening tests to their patients (forced choice question presented in Fig. 1), those who indicated using quantitative information scored significantly higher on the SNS than those who indicated using qualitative information (M = 5.04, SD = 0.681 and M = 4.78, SD = 0.718, respectively; $t = 2.24$, $P = 0.027$). Use of quantitative information as indicated on the forced-choice question was used as the dichotomous dependent variable in a logistic regression analysis with age (continuous variable), gender, number of cases of Down syndrome, and SNS score as predictors. Both age and SNS score predicted using quantitative information ($\beta = -0.05$, $P = 0.027$ and $\beta = 0.62$, $P = 0.030$, respectively). That is those who are younger and those who score higher on the SNS tend to use quantitative information.

Similar comparisons were made with the SNS subscales and the ONS. In a logistic regression analysis with age (continuous variable), gender, number of Down syndrome patients, and SNS-Ability subscale score as predictors, both age and SNS-Ability subscale score predicted using quantitative information ($\beta = -0.04$, $P = 0.047$ and $\beta = 0.55$, $P = 0.026$, respectively). However, in a logistic regression analysis with age (continuous variable), gender, and SNS-Preference subscale score as predictors, only age predicted using quantitative information ($\beta = -0.05$, $P = 0.02$). In a logistic regression analysis with age

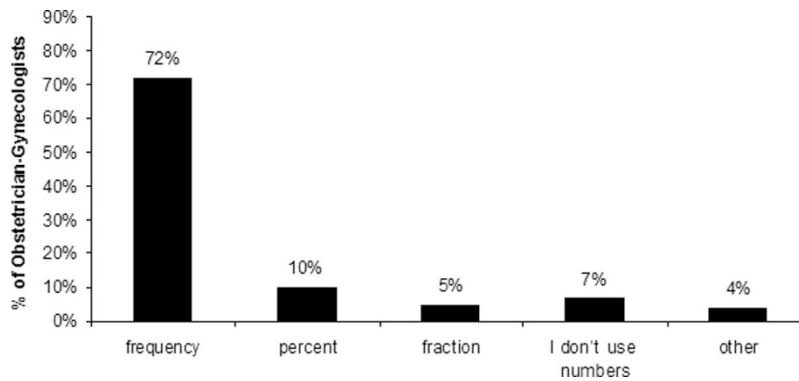

Fig. 3. Response to, "In general, if you use numbers to communicate or explain the risks associated with screening tests to patients (i.e., the likelihood of something), which do you most often use?" No responders indicated decimal. Many of those who said "other" indicated using frequency and percentages.

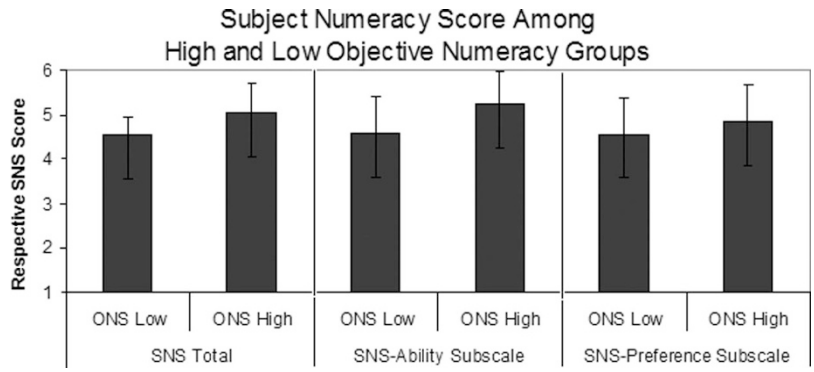

Fig. 4. Scores on the SNS total, SNS-Ability subscale, and SNS-Preference subscale among the high group (answered three of three questions correctly) and moderate/low groups (answered ≤2 of 3 correctly). The mean differences were significant for the SNS total, SNS-Ability subscale, and the SNS-Preference scale ($P < 0.001$, $P < 0.001$, and $P < 0.04$, respectively).

(continuous variable), gender, and ONS score as predictors, only age predicted using quantitative information ($\beta = -0.04$, $P = 0.03$).

DISCUSSION

Those who perceived themselves as having high abilities with numbers (high SNS and SNS-Ability scores) were more likely to use numbers to explain the screening results to their patients. Interestingly, neither the SNS-Preference subscale nor the ONS predicted whether they would use numbers. This suggests that physicians' use of quantitative information to explain screening test results depends on the perceived ability rather than their actual ability or their preferences for using numbers. One consequence of this association may be that the patients of physicians with low subjective numeracy may only be receiving qualitative information, which has been found to inflate patients' perceived risk.

We found that age also predicted communication strategy. These findings are in line with judgment and decision-making literature, which finds that older individuals tend to rely less on numerical information when making decisions.[13] However, older individuals often compensate for their numerical abilities by focusing on emotional goals and past experiences.[13]

Only a few studies have used both the SNS and an ONS in the same individuals and compared the findings,[4] and none have done so among physicians, to our knowledge. Our results suggest that, even though the two scales are weakly correlated, outcomes using the ONS do not always correspond to outcomes using the SNS. Although we found that SNS scores significantly predicted communication strategy, the ONS scores did not. We also found significant gender differences with the SNS but not the ONS; even though mean scores on the SNS were not very different, male ob-gyns reported a significantly higher subjective numeracy skills than female ob-gyns. Gender differences in math ability have actually been found to be very small.[14] These results suggest that the ONS and SNS measure different constructs. Our finding that physicians with higher subjective numeracy were more likely to use numbers suggests that the SNS and the SNS-Ability subscale may be a measure of math confidence, but rigorous comparison research needs to investigate this further.

Ob-gyns' communication of screening tests results varies, with approximately one in three ob-gyns providing numerical information, and frequency format being the commonly used numerical format. The use of qualitative labels when communicating Down syndrome screening test results has been found to be associated with greater perceived risk, more worry, and more interest in pursuing diagnostic testing.[4] Results from our study suggest that a majority of ob-gyns do not use labels to describe test results to their patients. In fact, the use of the labels "positive" and "abnormal" when the fetus was at an increased risk for Down syndrome were the least reported phrases in the explanations provided in the open-ended question.

An interesting further investigation would be to assess the format in which the laboratory results are presented to physicians and how that format influences their communication about screening results and their numeracy. The findings of this study might inform how laboratories present results to physicians. For example, some physicians prefer quantitative values, whereas others prefer qualitative descriptors. Presenting information in various quantitative and qualitative formats would allow physicians to choose the format that they are most comfortable communicating to patients.

In conclusion, the results of this study suggest that there is variation in how physicians provide information to patients about Down syndrome screening tests, with the plurality using numbers when communicating risks. However, the results also suggest that the type of communication that ob-gyns use is associated with their level of subjective numeracy and age but not objective numeracy or gender. These findings have implications for the quality of care for patients; physicians with low subjective numeracy may be using the less advantageous format in which to explain the rests from Down syndrome screening tests. Research on other aspects of care may highlight other ways in which physician numeracy impacts patient care.

ACKNOWLEDGMENTS

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REFERENCES

1. Driscoll DA, Morgan MA, Schulkin J. Screening for Down syndrome: changing practice of obstetricians. *Am J Obstet Gynecol* 2009;200:459 e451–e459.
2. ACOG Committee on Practice Bulletins. ACOG Practice Bulletin No. 77:

screening for fetal chromosomal abnormalities. *Obstet Gynecol* 2007;109: 217–227.
3. Grimes DA, Snively GR. Patients' understanding of medical risks: implications for genetic counseling. *Obstet Gynecol* 1999;93:910–914.
4. Zikmund-Fisher BJ, Smith DM, Ubel PA, Fagerlin A. Validation of the Subjective Numeracy Scale: effects of low numeracy on comprehension of risk communications and utility elicitations. *Med Decis Making* 2007;27:663–671.
5. Health literacy: report of the Council on Scientific Affairs. Ad Hoc Committee on Health Literacy for the Council on Scientific Affairs, American Medical Association. *JAMA* 1999;281:552–557.
6. Reyna VF, Nelson WL, Han PK, Dieckmann NF. How numeracy influences risk comprehension and medical decision making. *Psychol Bull* 2009;135:943–973.
7. Gigerenzer G, Gaissmaier W, Kurz-Milcke E, Schwartz LM, Woloshin S. Helping doctors and patients make sense of health statistics. *Psychol Sci Public Interest* 2007;8:53–96.
8. Rao G, Kanter SL. Physician numeracy as the basis for an evidence-based medicine curriculum. *Acad Med* 2010;85:1794–1799.
9. Bramwell R, West H, Salmon P. Health professionals' and service users' interpretation of screening test results: experimental study. *BMJ* 2006;333: 284.
10. Schwartz LM, Woloshin S, Black WC, Welch HG. The role of numeracy in understanding the benefit of screening mammography. *Ann Intern Med* 1997;127:966–972.
11. Estrada C, Barnes V, Collins C, Byrd JC. Health literacy and numeracy. *JAMA* 1999;282:527.
12. Fagerlin A, Zikmund-Fisher BJ, Ubel PA, Jankovic A, Derry HA, Smith DM. Measuring numeracy without a math test: development of the Subjective Numeracy Scale. *Med Decis Making* 2007;27:672–680.
13. Peters E, Diefenbach MA, Hess TM, Vastfjall D. Age differences in dual information-processing modes: implications for cancer decision making. *Cancer* 2008;113(suppl 12):3556–3567.
14. Hyde JS, Fennema E, Lamon SJ. Gender differences in mathematics performance: a meta-analysis. *Psychol Bull* 1990;107:139–155.

ERRATUM

Genetic counseling and testing for Alzheimer disease: Joint practice guidelines of the American College of Medical Genetics and the National Society of Genetic Counselors: Erratum

In the article that appeared on page 597 of volume 13, issue 6, the department of the first affiliation was incorrect. The first affiliation should appear as follows: Department of Neurology, Columbia University, New York, New York.

REFERENCE

Goldman JS, Hahn SE, Catania, JW, LaRusse-Eckert S, Butson MB, Rumbaugh M, et al. Genetic counseling and testing for Alzheimer disease: Joint practice guidelines of the American College of Medical Genetics and the National Society of Genetic Counselors. *Genet Med* 13:597–605.